CLAIMS

1. Transmitting apparatus comprising:

a. an array antenna including M (M is an integer of 2 or more) pieces of antenna elements for receiving a carrier modulation signal of a known symbol that is transmitting from a radio station;

b. a reference symbol generation means for generating a reference symbol that gives a phase reference and is the same symbol with the known symbol;

c. a propagation channel estimation means for generating M pieces of receiving symbols from a baseband signal received at the antenna elements based on the reference symbol, wherein the receiving symbols are estimate values for a complex propagation channel between a transmitting antenna and the array antenna.

2. Transmitting apparatus according to claim1, further comprising a carrier separation means for separating the baseband signal received at the M pieces of antenna elements into N (N is an integer of 2 or more) pieces of sub-carriers,

wherein:

the carrier modulation signal is configured by multiple carriers, and

said carrier separation means, after separating the received baseband signal into N (N is an integer of 2 or more) pieces of sub-carriers, generates "M x N" pieces of receiving symbols that are estimate values of a complex propagation channel based on the reference symbol.

3. Transmitting apparatus according to claim 1,

wherein:

said propagation channel estimation means, after applying a reverse spread separation process to the baseband signal received at the M pieces of antenna elements with N (N is an integer of 2 or more) pieces of spread codes, generates "M x N" pieces of receiving symbols that are estimate values of a complex propagation channel based on the reference symbol.

4. Transmitting apparatus according to claim 1,

wherein:

the M pieces of antenna elements configuring said array antenna have a mutually-different directional pattern, or mutually-different polarization.

5. Transmitting apparatus according to claim 2,

wherein:

the M pieces of antenna elements configuring said array antenna have a mutually-different directional pattern, or mutually-different polarization.

6. Transmitting apparatus according to claim 3,

wherein:

the M pieces of antenna elements configuring said array antenna have a mutually-different directional pattern, or mutually-different polarization.

7. Transmitting apparatus according to claim 1 further comprising:

a. a transmitting symbol calculation means for: calculating plural sets of transmitting symbol vectors from the M pieces of receiving symbols so that each transmitting symbol vector is configured by M pieces of transmitting symbols; then generating a reference table configured

by the plural sets of transmitting symbol vectors;

b. a symbol mapping means for generating M pieces of transmitting symbols by selecting one set of transmitting symbol vector from the reference table based on transmitting data; and

c. a single carrier modulation means for generating baseband signals from the M pieces of transmitting symbols.

8. Transmitting apparatus according to claim 2 further comprising:

a. a transmitting symbol calculation means for: calculating plural sets of transmitting symbol vectors from the "M x N" pieces of receiving symbols for each of N pieces of sub-carriers so that each vector is configured by M pieces of transmitting symbols; then generating reference tables configured by the plural sets of transmitting symbols vector;

b. a symbol mapping means for generating "M x N" pieces of transmitting symbols by selecting one set of transmitting symbol vector from each of N pieces of reference tables that correspond to the N pieces of sub-carriers based on a transmitting data; and

c. a single carrier modulation means for generating transmitting baseband signals from "M x N" pieces of transmitting symbols with N pieces of sub-carrier elements.

9. Transmitting apparatus according to claim 3 further comprising:

a. the transmitting symbol calculation means for: calculating plural sets of transmitting symbol vectors

from "M x N" pieces of receiving symbols for each of N pieces of spread codes so that each transmitting symbol vector is configured by M pieces of transmitting symbols; then generating reference tables configured by the plural sets of transmitting symbol vectors;

b. a symbol mapping means for generating "M x N" pieces of transmitting symbols by selecting one set of transmitting symbol vector from each of the N pieces of reference tables that correspond to the N pieces of spread codes respectively, based on a transmitting data including confidential information ; and

c. a single carrier modulation means for generating transmitting baseband signals from the "M x N" pieces of transmitting symbols by spread process with N pieces of reverse spread codes.

10. Transmitting apparatus according to claim 7,

wherein:

said transmitting symbol calculation means generates the plural sets of symbol vectors in order to control any one of receiving power and phase of the radio station.

11. Transmitting apparatus according to claim 8,

wherein:

said transmitting symbol calculation means generates the plural sets of symbol vectors in order to control any one of receiving power and phase of the radio station.

12. Transmitting apparatus according to claim 9,

wherein:

said transmitting symbol calculation means generates the plural sets of symbol vectors in order to control any one of receiving power/phase of the radio station.

13. Receiving apparatus comprising:

a. a propagation parameter estimation means for estimating a propagation parameter from a receiving signal; and

b. a symbol determination means for reconstructing a transmitting data based on the propagation parameter.

14. Receiving apparatus according to claim 13 further comprising a carrier separation means for separating the receiving signal , which is configured by multiple carriers, into a plurality of sub-carriers,

wherein:

said propagation parameter estimation means estimates a propagation parameter for each of the sub-carriers and the symbol determination means reconstructs a transmitting data from the receiving signal for each of the sub-carriers.

15. Receiving apparatus according to claim 14,

wherein:

the sub-carriers are any one of an OFDM signal that is so configured as to be mutually-orthogonal in a frequency space and a CDMA signal that is so configured as to be mutually-orthogonal in a code space.

16. Receiving apparatus according to claim 14 comprising:

an array antenna that is configured by at least one antenna element, wherein said propagation parameter estimation means estimates the propagation parameter for each of the antenna.

17. Receiving apparatus according to claim 15 comprising:

an array antenna that is configured by at least one antenna element, wherein said propagation parameter estimation means estimates the propagation parameter for each of the antenna.

18. Receiving apparatus comprising:

a. a propagation parameter estimation means for generating a receiving symbol that is a complex symbol by applying orthogonal detection to a received baseband signal; and

b. a symbol determination means for reconstructing a transmitting data from the receiving symbol based on predetermined criteria.

19. Receiving apparatus according to claim 18, further comprising:

a carrier separation means for separating the baseband signal, which is configured by a multiple carriers, into N (N is an integer of 2 or more) pieces of sub-carrier elements,

wherein:

said propagation parameter estimation means generates the receiving symbol for each of the sub-carriers after said carrier separation means separates the baseband signal into the sub-carriers.

20. Receiving apparatus according to claim 18,

wherein:

the symbol determination means reconstructs a transmitting data based on predetermined criteria after said propagation parameter estimation means applies a reverse spread process to the baseband signal with N (N is an integer of 2 or more) pieces of spread codes.

21. Receiving apparatus according to claim 19,

wherein:

said symbol determination means determines a symbol based on the receiving power of the antenna.

22. Receiving apparatus according to claim 20,

wherein:

said symbol determination means determines a symbol based on the receiving power of the antenna.

23. A radio communication method of transmitting a data on a single carrier from a first radio station to a second radio station, comprising the steps of:

a. transmitting an information known by both radio stations from the second radio station to the first radio station;

b. estimating a propagation parameter, which is a parameter of a propagation channel shared only between the first radio station and the second radio station, based on the known information and received information transmitted from the second radio station by the first radio station;

c. transmitting a data from the first radio station to the second radio station by superimposing the transmitting data including a confidential information on the estimated propagation parameter;

d. calculating a plurality of propagation parameters that are obtained from receiving signals of a plurality of antennas in the second radio station; and

e. reconstructing the transmitting data based on a plurality of propagation parameters calculated by the second radio

station.

24. A radio communication method of transmitting a data on a multiple carriers from a first radio station to a second radio station, comprising the steps of:

a. transmitting a information known by both radio stations from the second radio station to the first radio station;

b. estimating a propagation parameter, which is a parameter of a propagation channel shared only between the first radio station and the second radio stations, based on the known information and received information transmitted from the second radio station by the first radio station;

c. transmitting a data from the first radio station to the second radio station by superimposing the transmitting data on the estimated propagation parameter;

d. calculating a plurality of propagation parameters obtained from receiving signals of a plurality of antennas in the second radio station; and

e. reconstructing the transmitting data based on the a plurality of propagation parameters calculated in the second radio station.

25. A radio communication method according to claim 24, wherein:

the second radio station reconstructs the transmitting data based on the propagation parameter estimated from the receiving signal for each carrier configuring the multiple carriers.

26. A radio communication method according to claim 25,

wherein:

each carrier configuring the multiple carriers is any one of a OFDM signal that is so configured as to be mutually-orthogonal in a frequency space and a CDMA signal that is so configured as to be mutually-orthogonal in a code space.

27. A radio communication system of transmitting a data by a single carrier modulation method from a first radio station to a second radio station, comprising:

a. the first radio station comprising;

(a1) a propagation channel estimation means for estimating a propagation channel parameter shared only between the first radio station and the second radio station, when the first radio station transmits a data including a confidential information to a second radio station; and

(a2) a transmitting means for transmitting a data from the first radio station to the second radio station by superimposing a transmitting signal on the estimated propagation channel parameter;

and

b. the second radio station comprising;

(b1) a propagation parameter estimation means for calculating a plurality of propagation parameters obtained from receiving signals of a plurality of antennas; and

(b2) a symbol determination means for reconstructing a transmitting data from the first radio station based on a plurality of the calculated propagation parameters,

wherein:

the data transmitting from the first radio station to the second radio station includes confidential information.